



Clinical Update

Naval Postgraduate Dental School
Navy Medicine Manpower, Personnel,
Training and Education Command
Bethesda, Maryland

Vol. 32, No. 7

2010

Differential diagnosis and management of cracked teeth

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INTRODUCTION

Patients with cracked teeth can exhibit a variety of symptoms which may be difficult to diagnose. In 1964, Cameron described multiple cases of individuals with symptoms of acute pain upon chewing that were associated with cracked teeth. He referred to these patients as having “cracked tooth syndrome” (1). These patients may also be asymptomatic or suffer periodic pain; having highly variable symptoms and presentations. This can be a challenge for the clinician trying to achieve a definitive pulpal diagnosis, therefore “cracked tooth syndrome” should not be used as a diagnostic term (2). Historically, there have been multiple classification systems used to describe cracked teeth (3). In 2008, The American Association of Endodontists published a classification system listing five types of longitudinal tooth fractures: 1. *Craze Lines*: localized fractures within enamel not penetrating dentin (4). 2. *Fractured Cusp*: incomplete or complete fracture of the cusp. Crack propagates until it terminates subgingivally (3,4). 3. *Cracked Tooth*: Often crack is located in a mesial-distal direction, often involves one or both marginal ridges, is centered in the crown, and extends apically, thus causing pulpal and apical pathosis (4). 4. *Split Tooth*: Complete fracture of the tooth. Fracture originates within the crown, usually in a mesial-distal direction and migrates apically until the tooth is split into two distinct segments (4). 5. *Vertical Root Fracture*: Most difficult to diagnose. Complete or incomplete and is usually located buccolingually. Crack can occur at any level along the root surface and propagate along the entire length of the root (4). This type of fracture may arise from physical trauma, repetitive parafunctional habits, heavy chewing stresses, or may be caused by iatrogenic dentistry (2).

This clinical update will focus on the diagnosis and management of cracked teeth as well as teeth with vertical root fractures. Topics will include prevalence, etiology of pain, history, evaluation, armamentarium necessary for diagnosis, and treatment.

PREVALENCE

Cracked teeth

In a 10 year study, Cameron found mandibular second molars had the highest frequency of cracks, followed by mandibular first molars, maxillary premolars, maxillary second molars, maxillary first molars, and maxillary third molars (5). Ratcliff et al. concluded that restorations place teeth at a much higher risk of cracks (6). Whereas, Roh & Lee found that 60% of cracked teeth did not have any restorations (7). They found that the highest frequency of cracks were in the maxillary first molar followed by the maxillary second molar, mandibular first molar, mandibular second molar, maxillary premolars, and mandibular premolars (7).

Vertical Root Fractures

Cohen et al. found the incidence of vertical root fractures to be 23% for maxillary premolars, 21.59% for mandibular first molars and 21.15% for mandibular second molars (8). Berman et al. evaluated nonvital teeth which either had no restorations or minimally invasive restorations. Pulpal necrosis was speculated to be due to an

undiagnosed longitudinal fracture extending from the occlusal surface into the pulp chamber and canal system (9).

ETIOLOGY OF PAIN

Most patients with cracked teeth experience pain when chewing. As the patient bites and releases, the cracked segment flexes exposing the dentinal tubules. This causes a rapid movement of dentinal fluid within the tubules that can stimulate A-delta fibers and elicit pain. Dentinal tubules will also be exposed to bacteria and bacterial toxins. If these toxins enter the pulp, an inflammatory process is triggered, which can lead to chronic inflammation and the development of hyperalgesia (3,10).

HISTORY

Thorough medical and dental histories can provide invaluable information to the clinician. It is important to question the patient regarding the history of symptoms and any event that may have initiated the problem. Also inquire regarding the restorative history of the tooth and evaluate the patient for parafunctional habits (2).

DIAGNOSIS

It is imperative to conduct a complete examination and utilize the available armamentarium to diagnosis cracks and fractures.

Clinical evaluation

Examine occlusal wear patterns and dark staining cracks. Perform a tactile examination using a sharp explorer to detect possible cracks (11). An invaluable aid is magnification and illumination using dental loupes or a dental operating microscope. Pulp testing should be completed for teeth with suspected fractures.

Periodontal examination

Perform periodontal probing and evaluate for evidence of any narrow isolated defect (2). This can be indicative of a vertical root fracture (2). Additionally, look for evidence of a sinus tract draining through the sulcus or multiple sinus tracts (2). Conduct a thorough soft tissue exam and look for sinus tracts in or near the attached gingiva, as this is often pathognomonic for vertical root fractures (3).

Radiographic evaluation

Cracks are seldom seen radiographically (4). Evaluate multiple angled radiographs and note reparative features such as a receded pulp chamber and canal and widening of PDL space (4). As the crack deepens, bony defects may appear over time. Look for a J-shaped or halo-like radiolucency that may encompass the root and possibly involve the furcation (2, 4). Cone Beam Computed Tomography (CBCT) can be used as a supplement, however not a replacement, to conventional radiography. CBCT scans have been found to be more accurate than periapical radiographic images in detecting vertical root fractures (12).

Transillumination

Transillumination is an excellent diagnostic tool since the crack will block light transmission through the tooth (2). This is especially

useful for identification of fractured cusps. Abbott found that 23% of 245 restored teeth could be diagnosed as having cracks prior to the restoration being removed. After removal of restorations and transillumination, he found that 60% of these teeth had cracks. If the tooth has a restoration, it is recommended that the restoration be removed prior to transillumination (13).

Tooth Slooth®

Perform a bite test. Have the patient bite on a Tooth Slooth®, or chew on a cotton roll to reproduce the pain and to isolate a specific area of the tooth (11, 15). In addition, it is prudent to use the bite test on other teeth for comparison (4).

Banding

A stainless steel orthodontic band can be placed as a diagnostic aid. After cementation of the band, repeat the diagnostic bite test to see if symptoms are alleviated (11, 15).

Dyes

Staining the tooth surface, cavity preparation or root with methylene blue can reveal cracks (11). If endodontic treatment is necessary, carefully evaluate the internal aspect of the chamber for a crack.

Surgical exploration

If the above methods are unsuccessful, then surgical exploration may be used to assess and more definitively diagnose the extent of a vertical root fracture (11).

TREATMENT

Type of fracture and results of diagnostic tests will help determine the appropriate treatment. Teeth diagnosed with craze lines do not require treatment. Common etiologies of fractured cusps are marginal ridges that have been undermined by caries or restoration (3). The treatment of choice in these cases would be to remove the affected cusp and restore the tooth. Pane et al. found that cementation of a stainless steel band could double the fracture resistance of cracked teeth (14). The cemented orthodontic band acts as a splint and can be used as a diagnostic aid and temporary treatment prior to full coverage (15). Consider full cuspal reinforcement with a restoration such as a crown or bonded restoration. Opdam et al. revealed that cracked teeth with full cuspal coverage had no failures in 7 years, and teeth without full cuspal coverage had a 6% failure rate per year (16). Placement of a crown on cracked teeth with reversible pulpitis resulted in endodontic treatment not being required in 79% of the cases over a 6 month period (17). Evaluate those with split tooth, or vertical root fracture, for possible root amputation. If root amputation is not possible, extraction is necessary.

CONCLUSION

Diagnosis of fractured teeth can be challenging and frustrating to both clinician and patient. Many patients suffer for years due to lack of definitive diagnoses. Often patients have consulted different dentists in search of resolution and may have experienced many unscheduled dental visits with multiple restorations and occlusal adjustments with no resolution of their chief complaint. It is essential that the clinician have a thorough understanding of the etiology, diagnostic aids, and options that are available for the proper treatment of cracked teeth. Early diagnosis and treatment of incomplete fractures are paramount in order to limit crack propagation and micro-leakage, thus preventing irreversible damage to the pulp and apical tissues (3).

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